

Valvular Heart Disease

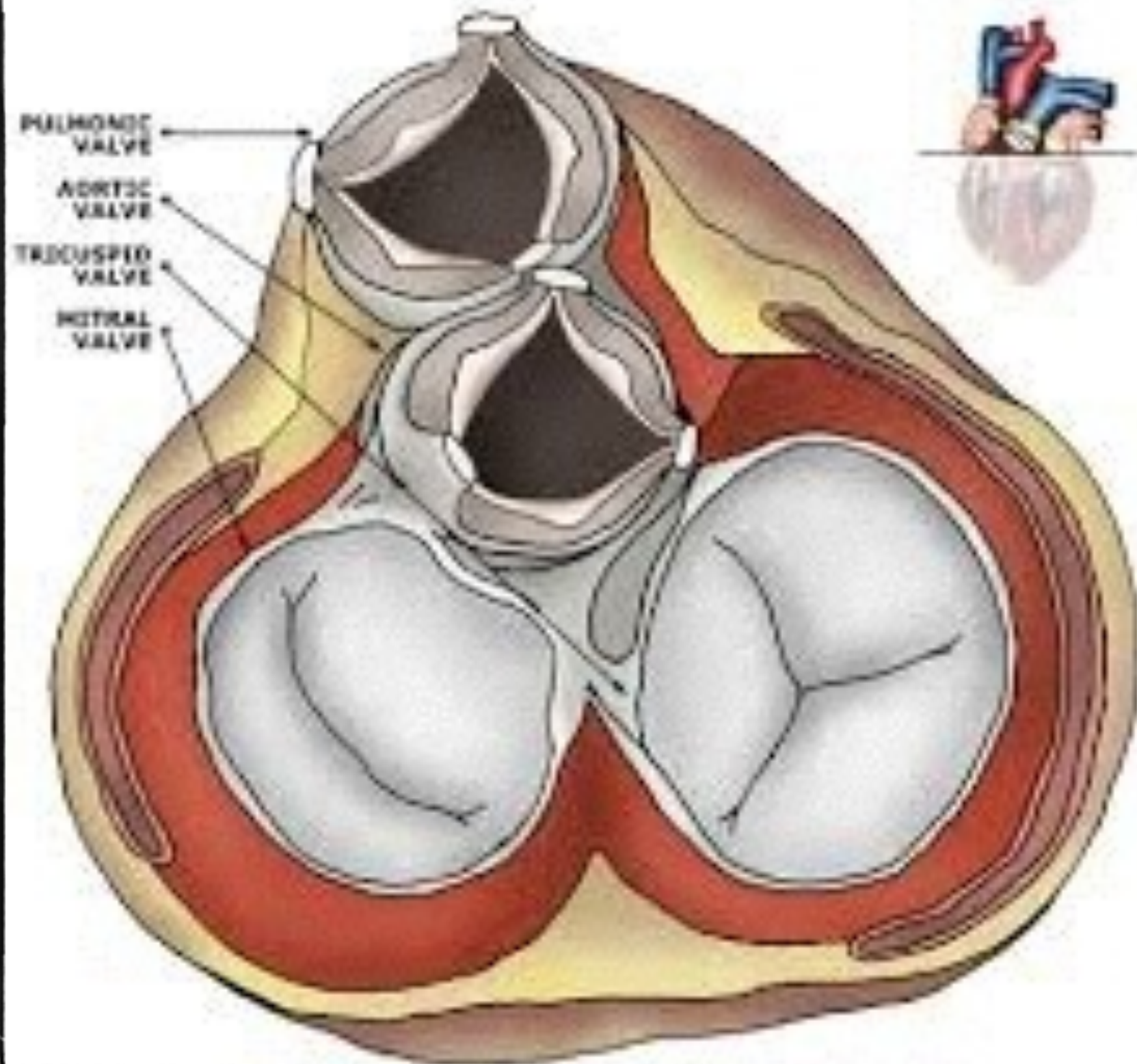
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Chairman of medicine

Mitral Stenosis

THE HEART IN SYSTOLE



A 75 year old woman with loud first heart sound and mid-diastolic murmur

- ◆ Chronic dyspnea Class 2/4
- ◆ Fatigue
- ◆ Recent orthopnea/PND
- ◆ Nocturnal palpitation
- ◆ Pedal edema

Mitral Stenosis

- ◆ Etiology
- ◆ Symptoms
- ◆ Physical Exam
- ◆ Severity
- ◆ Natural history
- ◆ Timing of Surgery

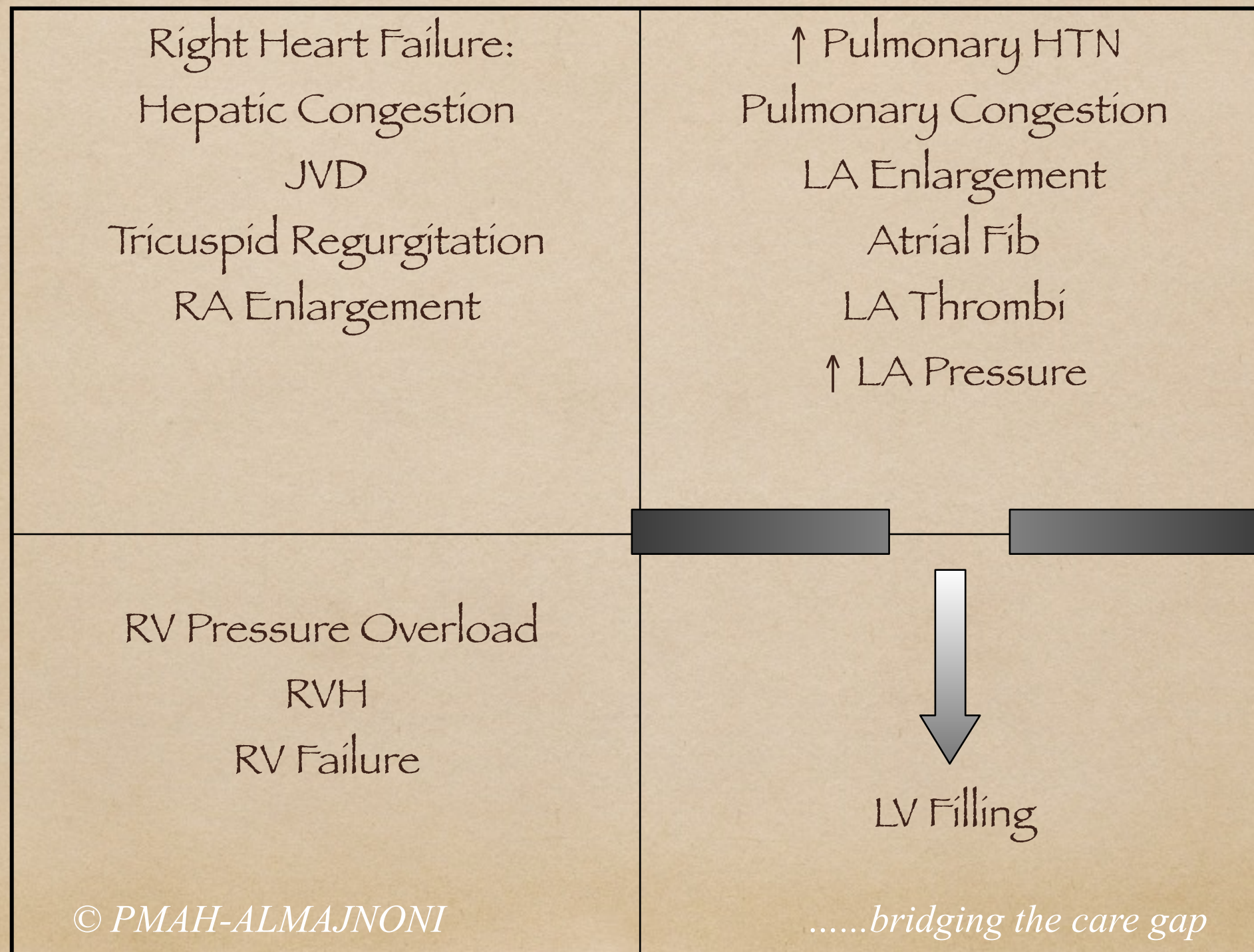
Mitral Stenosis: Etiology

- ◆ Primarily a result of rheumatic fever
(~ 99% of MV's @ surgery show rheumatic damage)
- ◆ Scarring & fusion of valve apparatus
- ◆ Rarely congenital
- ◆ Pure or predominant MS occurs in approximately 40% of all patients with rheumatic heart disease
- ◆ Two-thirds of all patients with MS are female.

Mitral Stenosis: Pathophysiology

- ◆ Normal valve area: 4-6 cm²
- ◆ Mild mitral stenosis:
 - ◆ MVA 1.5-2.5 cm²
 - ◆ Minimal symptoms
- ◆ Mod. mitral stenosis
 - ◆ MVA 1.0-1.5 cm² usually does not produce symptoms at rest
- ◆ Severe mitral stenosis
 - ◆ MVA < 1.0 cm²

Mitral Stenosis: Pathophysiology



Mitral Stenosis: Symptoms

- ◆ Fatigue
 - ◆ Palpitations
 - ◆ Cough
 - ◆ SOB
 - ◆ Left sided failure
 - ◆ Orthopnea
 - ◆ PND
 - ◆ Palpitation
- Afib
 - Systemic embolism
 - Pulmonary infection
 - Hemoptysis
 - Right sided failure
 - Hepatic Congestion
 - Edema
 - Worsened by conditions that ↑ cardiac output.
 - Exertion, fever, anemia, tachycardia, Afib, intercourse, pregnancy, thyrotoxicosis

Recognizing Mitral Stenosis

Palpation:

- ◆ Small volume pulse
- ◆ Tapping apex-palpable S1
- ◆ +/- palpable opening snap (OS)
- ◆ RV lift
- ◆ Palpable S2

ECG:

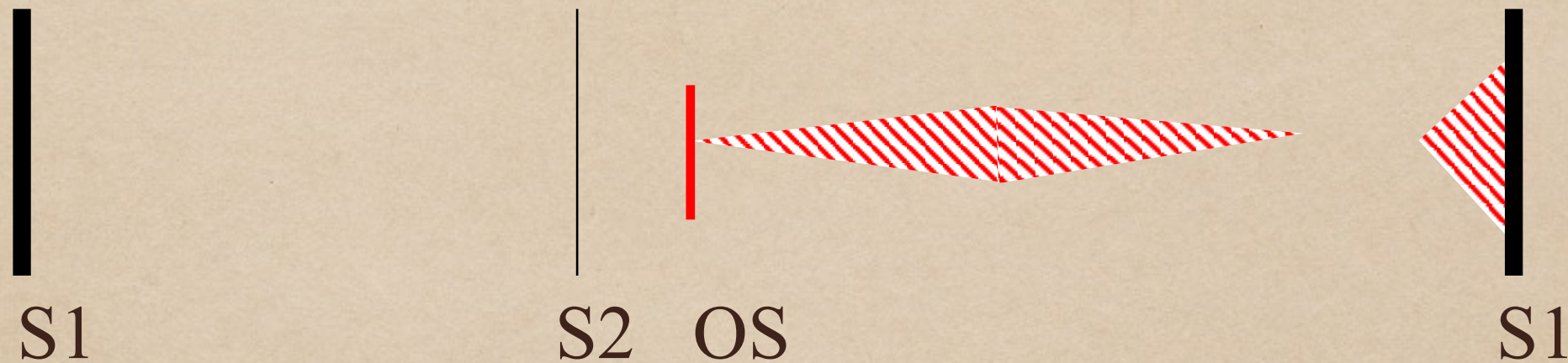
- ◆ LAE, AFIB, RVH, RAD

Auscultation:

- Loud S1- as loud as S2 in aortic area
- A2 to OS interval inversely proportional to severity
- Diastolic rumble: length proportional to severity
- In severe MS with low flow- S1, OS & rumble may be inaudible



Mitral Stenosis: Physical Exam



- ◆ First heart sound (S1) is accentuated and snapping
- ◆ Opening snap (OS) after aortic valve closure
- ◆ Low pitch diastolic rumble at the apex
- ◆ Pre-systolic accentuation (esp. if in sinus rhythm)

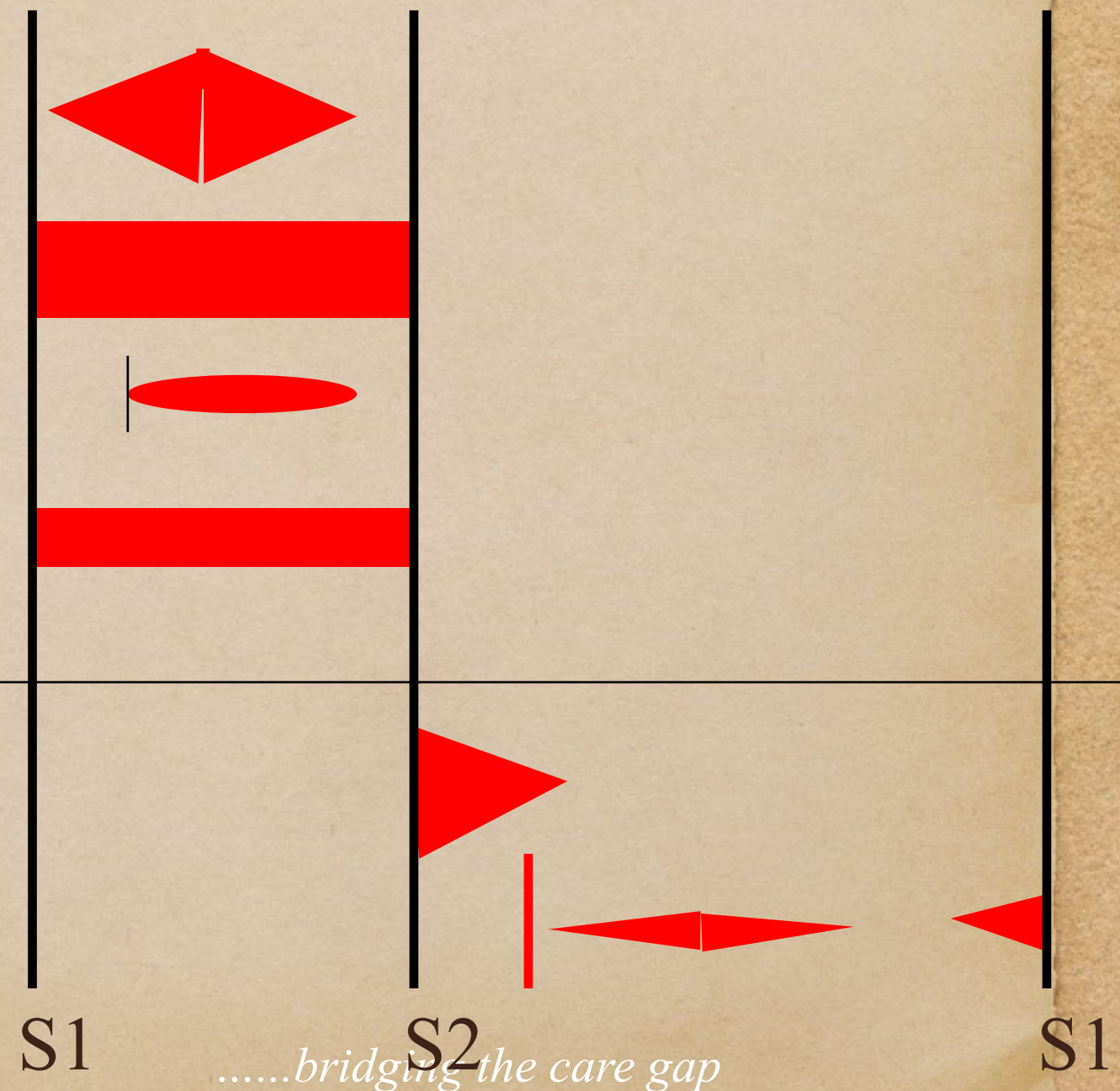
Common Murmurs and Timing

Systolic Murmurs

- ◆ Aortic stenosis
- ◆ Mitral insufficiency
- ◆ Mitral valve prolapse
- ◆ Tricuspid insufficiency

Diastolic Murmurs

- ◆ Aortic insufficiency
- ◆ Mitral stenosis



Mitral Stenosis: Natural History

- ◆ Progressive, lifelong disease,
- ◆ Usually slow & stable in the early years.
- ◆ Progressive acceleration in the later years
- ◆ 20-40 year latency from rheumatic fever to symptom onset.
- ◆ Additional 10 years before disabling symptoms

Mitral Stenosis: Complications

- ◆ Atrial dysrrhythmias
- ◆ Systemic embolization (10-25%)
 - ◆ Risk of embolization is related to, age, presence of atrial fibrillation, previous embolic events
- ◆ Congestive heart failure
- ◆ Pulmonary infarcts (result of severe CHF)
- ◆ Hemoptysis
 - ◆ Massive: 2^o to ruptured bronchial veins (pulm HTN)
 - ◆ Streaking/pink froth: pulmonary edema, or infection
- ◆ Endocarditis
- ◆ Pulmonary infections

Mitral Stenosis: EKG

- ◆ LAE
- ◆ RVH
- ◆ Premature contractions
- ◆ Atrial flutter and/or fibrillation
 - ◆ ↑ freq. in pts with mod-severe MS for several years
 - ◆ A fib develops in $\approx 30\%$ to 40% of pts w/
symptoms

Mitral Stenosis: Therapy

- ◆ Medical
 - ◆ Diuretics for LHF/RHF
 - ◆ Digitalis/Beta blockers/CCB: Rate control in A Fib
 - ◆ Anticoagulation: In A Fib
 - ◆ Endocarditis prophylaxis
- ◆ Balloon valvuloplasty
 - ◆ Effective long term improvement

Mitral Stenosis: Therapy

- ◆ Surgical
 - ◆ Mitral commissurotomy
 - ◆ Mitral Valve Replacement
 - ◆ Mechanical
 - ◆ Bioprosthetic

Mitral Regurgitation

Mitral Regurgitation

- ◆ Etiology
- ◆ Symptoms
- ◆ Physical Exam
- ◆ Severity
- ◆ Natural history
- ◆ Timing of Surgery

An 80 year old woman with increasing dyspnea

- ◆ Longstanding heart murmur
- ◆ Increasing dyspnea & fatigue
- ◆ Recent ER visit Dx CHF



Mitral Regurgitation: Etiology

- ◆ Valvular-leaflets
 - ◆ Myxomatous MV Disease
 - ◆ Rheumatic
 - ◆ Endocarditis
 - ◆ Congenital-clefts
- ◆ Chordae
 - ◆ Fused/inflammatory
 - ◆ Torn/trauma
 - ◆ Degenerative
 - ◆ IE
- Annulus
 - Calcification, IE (abcess)
- Papillary Muscles
 - CAD (Ischemia, Infarction, Rupture)
 - HCM
 - Infiltrative disorders
- LV dilatation & functional regurgitation
- Trauma

MR Etiology: Surgical series

- ◆ MVP (20-70%)
- ◆ Ischemia (13-40%)
- ◆ RHD (3-40%)
- ◆ Infectious endocarditis (10-12%)

MR Pathophysiology

- ◆ Chronic LV volume overload -» compensatory LVE initially maintaining cardiac output
- ◆ Decompensation (increased LV wall tension) -» CHF
- ◆ LVE - » annulus dilation - » increased MR
- ◆ Backflow - » LAE, Afib, Pulmonary HTN

MR Symptoms

- ◆ Similar to MS
- ◆ Dyspnea, Orthopnea, PND
- ◆ Fatigue
- ◆ Pulmonary HTN, right sided failure
- ◆ Hemoptysis
- ◆ Systemic embolization in A Fib

Recognizing Chronic Mitral Regurgitation

- ◆ Pulse:
 - ◆ brisk, low volume
 - ◆ Apex:
 - ◆ hyperdynamic
 - ◆ laterally displaced
 - ◆ palpable S3 +/- thrill
 - ◆ late parasternal lift 2° to LA filling
 - ◆ S1 soft or normal
 - ◆ S2 wide split (early A2) unless LBBB
- Murmur-Fixed MR:
 - pansystolic
 - loudest apex to axilla
 - no post extra-systolic accentuation
 - Murmur-Dynamic MR(MVP)
 - mid systolic
 - +/- click
 - ↑ upright
 - S3 / flow rumble if severe

Recognizing Acute Severe Mitral Regurgitation

- ◆ Acute severe dyspnea, CHF & hypotension
- ◆ LV size normal
- ◆ LV may/may not be hyperdynamic
- ◆ Loud S1
- ◆ Systolic murmur may/may not be pan-systolic
- ◆ Inflow/rumble
- ◆ S3 present-may be only abnormality
- RV lift
- TTE/TEE for diagnosis
 - Chordal or papillary muscle rupture/tear
 - Infarction with papillary muscle ischaemia or tear
 - Infectious endocarditis with leaflet perforation or disruption or chordal tear
 - Flail MV segment

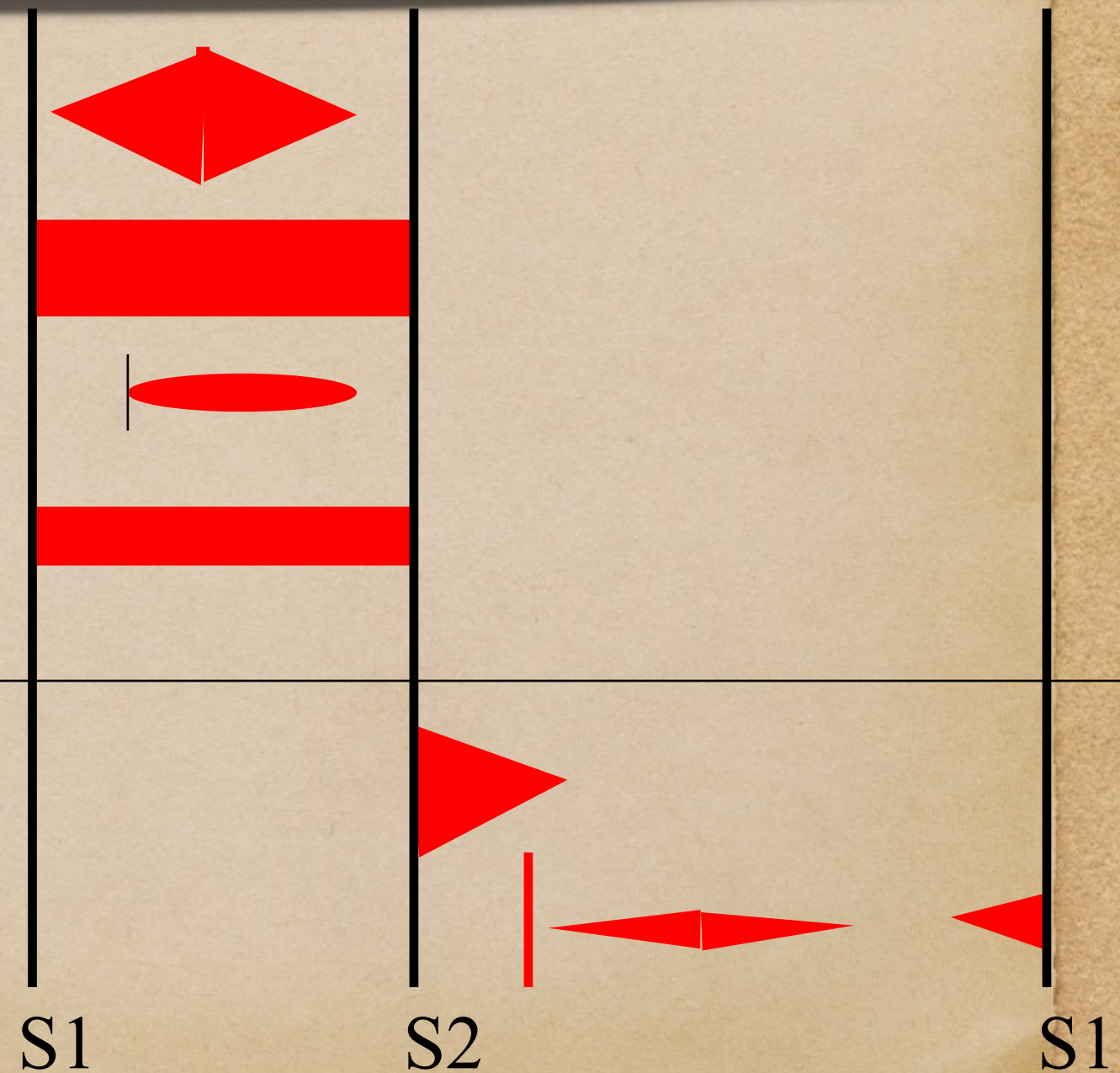
Comparing AS and MR

Systolic Murmurs

- ◆ Aortic stenosis
- ◆ Mitral insufficiency
- ◆ Mitral valve prolapse
- ◆ Tricuspid insufficiency

Diastolic Murmurs

- ◆ Aortic insufficiency
- ◆ Mitral stenosis



Assessing Severity of Chronic Mitral Regurgitation

Measure the Impact on the LV:

- ◆ Apical displacement and size
- ◆ Palpable S3
- ◆ Longer/louder MR murmur (chronic MR)
- ◆ S3 intensity/ length of diastolic flow rumble
- ◆ Wider split S2 (earlier A2) unless HPT narrows the split

Recognizing Mitral Regurgitation

◆ ECG:

- ◆ LA enlargement
- ◆ Afib
- ◆ LVH (50% pts. With severe MR)
- ◆ RVH (15%)
- ◆ Combined hypertrophy (5%)

• CXR:

- ↑ LV
- ↑↑ LA
- ↑ pulmonary vascularity
- CHF
- Ca++ MV/MAC

Mitral Valve Surgery

- ◆ Only effective treatment is valve repair/replacement
- ◆ Optimal timing determined:
 - ◆ Presence/absence of symptoms
 - ◆ Functional state of ventricle
 - ◆ Feasability of valve repair
 - ◆ Presence of Afib/PHTN
 - ◆ Preference/expectations of patient

Surgical Therapy - Timing

- ◆ Surgery reduces morbidity and mortality from severe MR but exposes patient to risk of surgery and prosthetic valve
- ◆ Surgery should be performed before onset of severe symptoms or development of LV contractile dysfunction

Symptoms

- ◆ Class III or IV symptoms (even if transient) always indicate need for surgery
- ◆ Class II symptoms indicate need for surgery in patients with repairable valves
- ◆ ETT may reveal concealed symptoms

Ejection Fraction (LVEF)

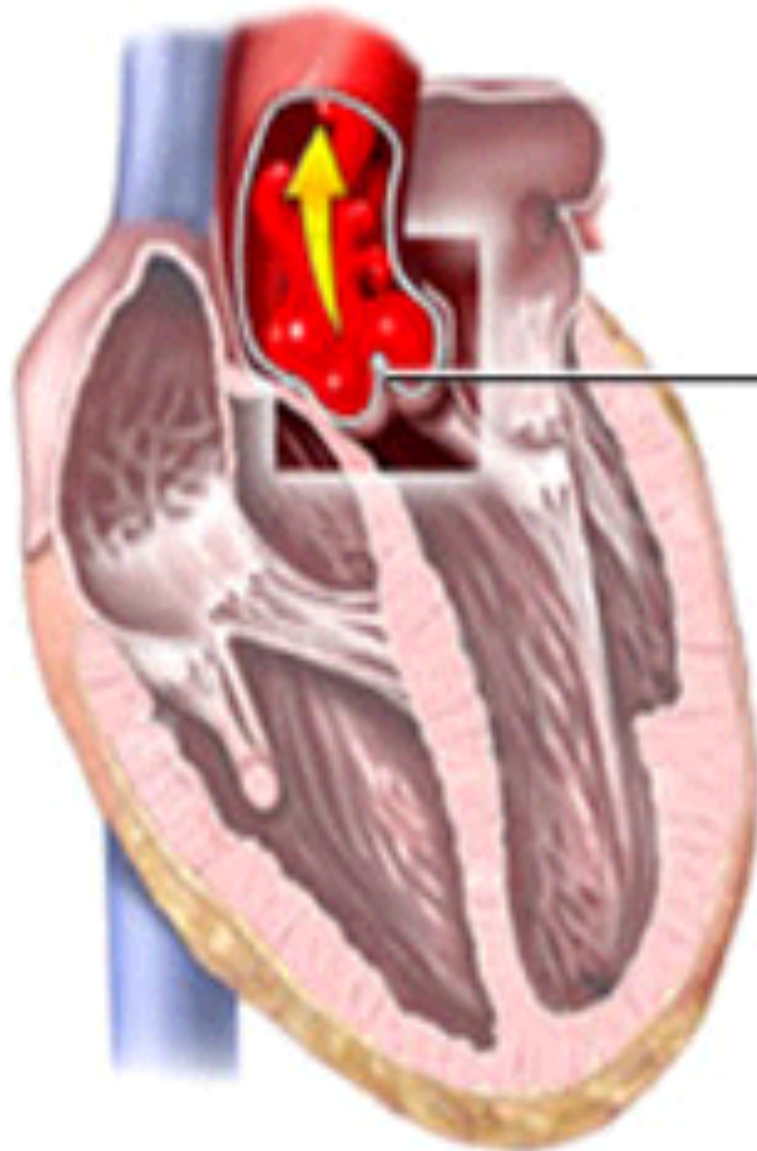
- ◆ Strongest predictor of outcome following surgery
- ◆ Should be assessed quantitatively
 - ◆ MUGA or Echo
- ◆ Surgery indicated if LVEF is below normal (60%)
- ◆ If EF normal, follow every 6 to 12 months
- ◆ If EF <30%, medical management (valve repair experimental in this setting)

Other Indications

- ◆ Flail mitral leaflet
- ◆ Left atrial dimension >45mm
- ◆ Paroxysmal atrial fibrillation
- ◆ Pulmonary hypertension

Aortic Regurgitation

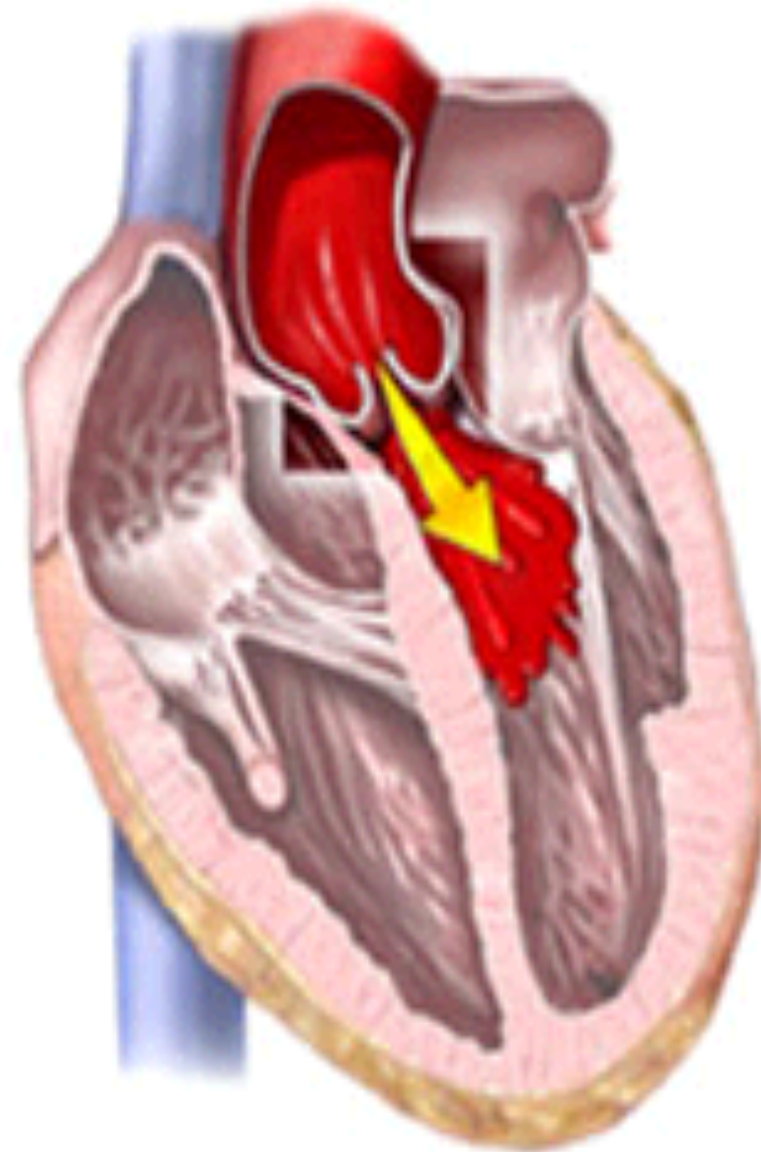
Normal valve
operation



Aortic
valve

Valve closes after
left ventricle pumps
blood into aorta

Leakage
of valve



Valve does not close
completely, leaking
blood into heart

Aortic Regurgitation

- ◆ This is leakage of blood from aorta to LV during diastole
- ◆ Causes:
 - # Congenital
 - Bicuspid valve or disproportionate cusp
 - # Acquired
 - Rheumatic Disease
 - Infective Endocarditis
 - Trauma
 - Aortic Dilatation (Marfan syndrome, aneurysm, dissection, syphilis)

Clinical Features

◆Symptoms

Mild – moderate AR often asymptomatic

Awareness of heart beat “pulsation”

Severe AR – Breathlessness, Angina

◆Signs

Pulse

Large volume or collapsing pulse

Bounding peripheral pulse

INVESTIGATION

- ◆ ECG – LVH
- ◆ X-ray – Cardiac Dilatation, features of LVH
- ◆ Echocardiogram

Management

1. Treatment for endocarditis
2. AVR indicated if AR causes symptoms
3. Vasodilators have been shown to prevent left ventricular dilatation
4. When aortic root dilatation is cause of AR aortic root replacement may be necessary

Aortic Stenosis

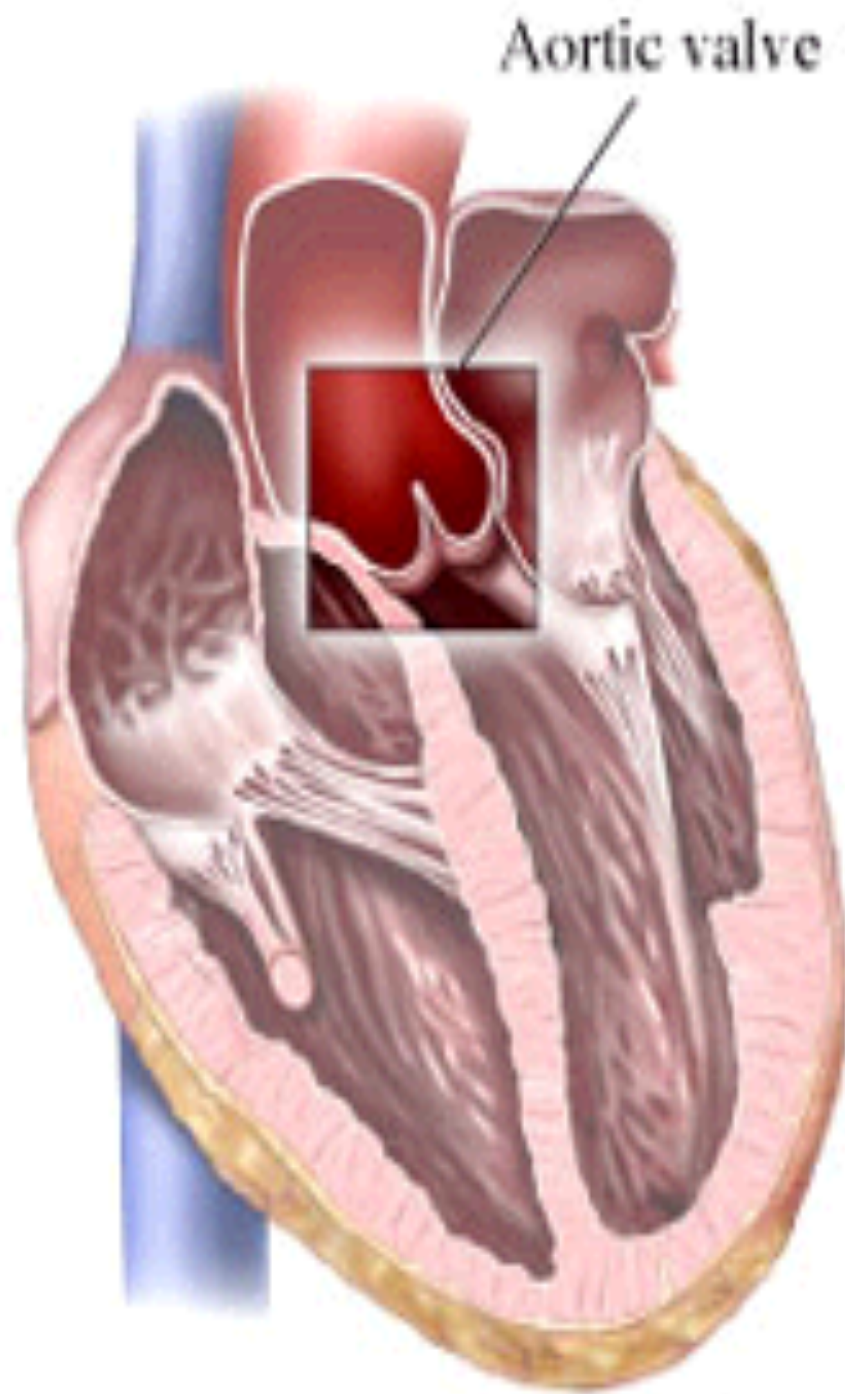


**having a bad day?
remember, it can always be worse**



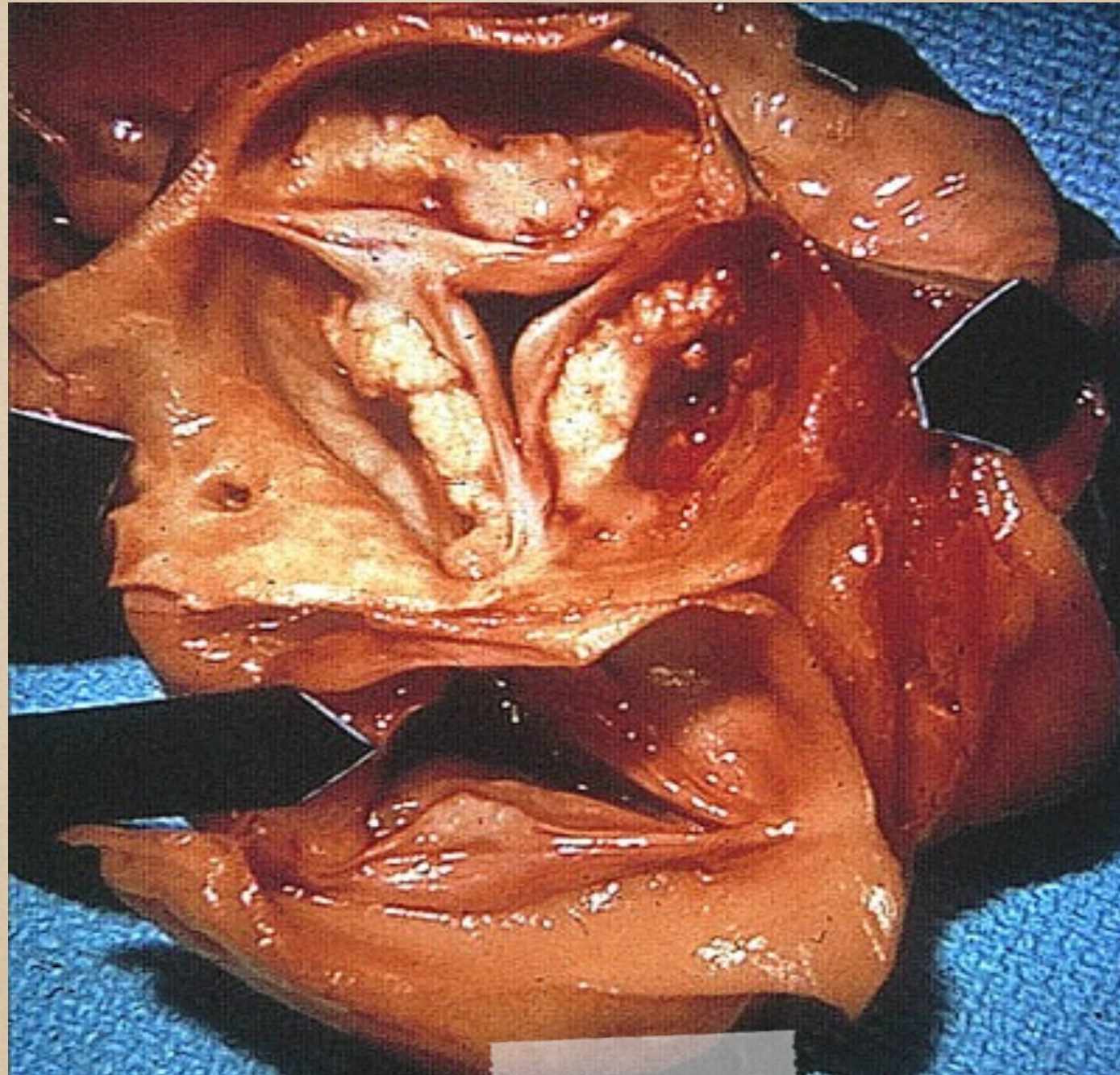
Quail

Normal tricuspid aortic valve



Bicuspid aortic valve





Valvular Aortic stenosis

Left Ventricular Hypertrophy



LVH Aortic Stenosis

Investigation

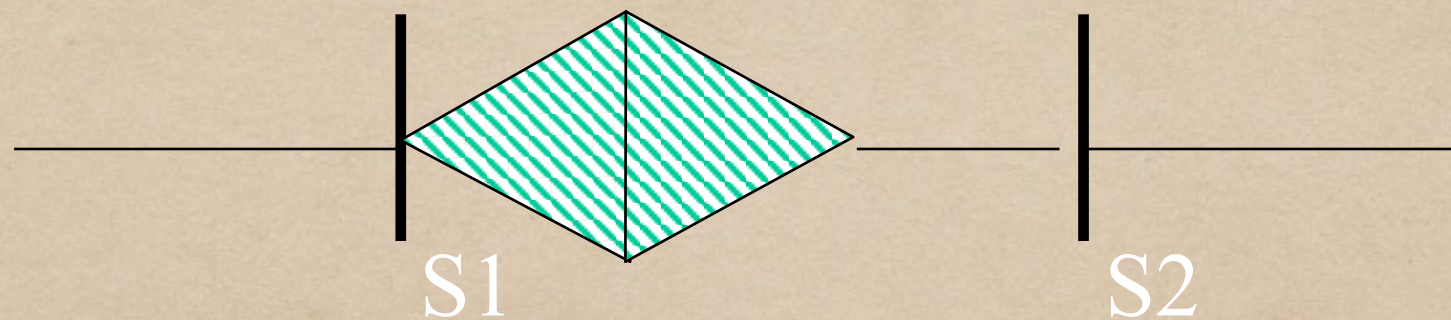
- ◆ ECG – LVH, LBBB
- ◆ X-ray – LV enlargement
- ◆ Echocardiogram

Aortic Stenosis

- ◆ Etiology
- ◆ Physical Examination
- ◆ Assessing Severity
- ◆ Natural History
- ◆ Prognosis
- ◆ Timing of Surgery

Innocent Murmurs

- ◆ Common in asymptomatic adults
- ◆ Characterized by
 - ◆ Grade I – II @ LSB
 - ◆ Systolic ejection pattern



- Normal intensity & splitting of second sound (S2)
- No other abnormal sounds or murmurs
- No evidence of LVH, and no ↑ with Valsalva

An 83 year old man with exertional dyspnea

- ◆ Previously well
- ◆ Gradual onset Class 2/3
- ◆ Occasional lightheaded
- ◆ O/E: 2/6 ejection murmur



An 83 year old man with exertional dyspnea

- ◆ Is there significant valvular heart disease?
- ◆ Which valve?
- ◆ Is the valve playing a role in his dyspnea?
- ◆ How do you distinguish AV sclerosis from stenosis?
- ◆ What are the clinical signs of severe AS?
- ◆ What tests are appropriate?
- ◆ When is surgery indicated?

Aortic Stenosis: Symptoms

- ◆ Cardinal Symptoms
 - ◆ Chest pain (angina)
 - ◆ Reduced coronary flow reserve
 - ◆ Increased demand-high afterload
 - ◆ Syncope/Dizziness (exertional pre-syncope)
 - ◆ Fixed cardiac output
 - ◆ Vasodepressor response
 - ◆ Dyspnea on exertion & rest
 - ◆ Impaired exercise tolerance
- ◆ Other signs of LV failure
 - ◆ Diastolic & systolic dysfunction

Clinical Features

◆ Signs

Ejection systolic murmur

Slow rising carotid pulse

Narrow pulse pressure

Thirsting apex beat (LV pressure overload)

Signs of pulmonary venous congestion

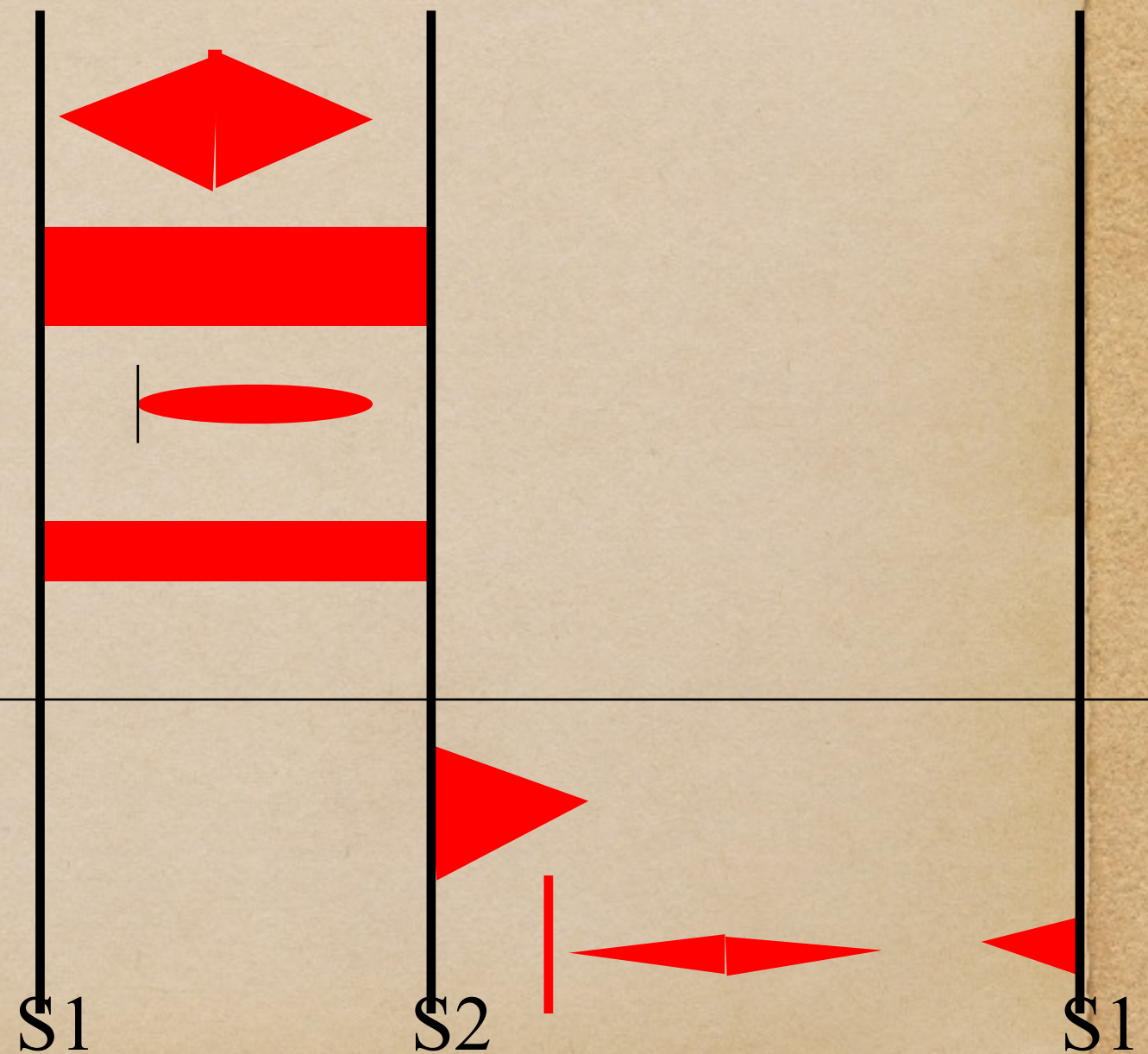
Common Murmurs and Timing (click on murmur to play)

Systolic Murmurs

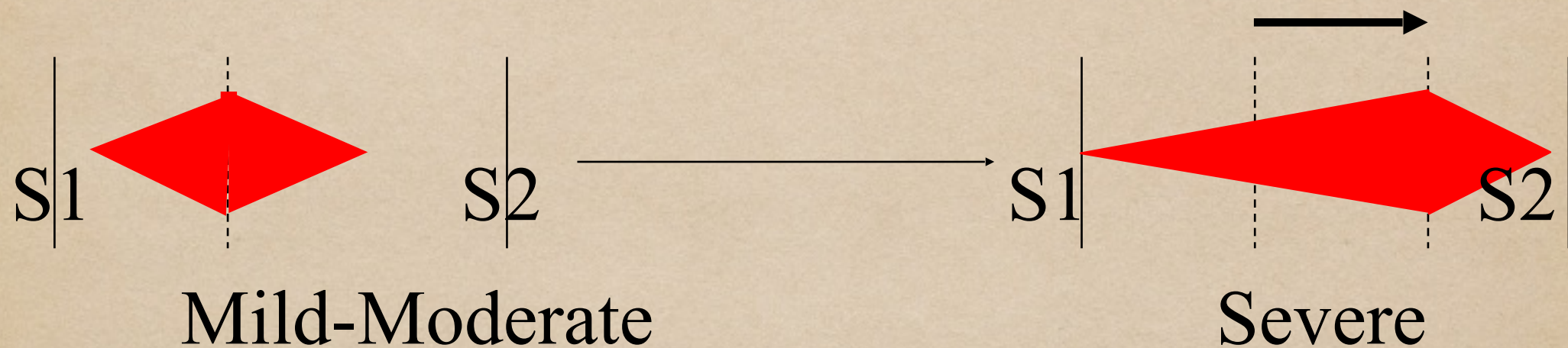
- ◆ Aortic stenosis
- ◆ Mitral insufficiency
- ◆ Mitral valve prolapse
- ◆ Tricuspid insufficiency

Diastolic Murmurs

- ◆ Aortic insufficiency
- ◆ Mitral stenosis



Aortic Stenosis: Physical Findings



Aortic Stenosis: Physical Findings

- ◆ Intensity DOES NOT predict severity
- ◆ Presence of thrill DOES NOT predict severity
- ◆ “Diamond” shaped, harsh, systolic crescendo-decrescendo
- ◆ Decreased, delay & prolongation of pulse amplitude
- ◆ Paradoxical S2
- ◆ S4 (with left ventricular hypertrophy)
- ◆ S3 (with left ventricular failure)

Recognizing Aortic Stenosis

Sign	Correlation with Severity
JVP-prominent A wave	No
Carotid-delayed, anacrotic	Yes
A2 audible over carotids	If A2 transmitted to carotids mean AV gradient < 50 mm Hg and stenosis not severe
Apex- sustained, atrial kick	Yes
-enlarged, displaced	Yes
Thrill	No
Cardiomegaly- Clinical/CXR	Yes
Soft S1	Yes
Paradoxical S2	Yes
S3, S4	Yes
SEM- intensity	No
- late peak	Yes
ECG- LAE, LVH	Yes

Aortic Stenosis. - Etiology

- ◆ Young patient think congenital

- ◆ Bicuspid

- ◆ 2% population
- ◆ 3:1 male:female distribution
- ◆ Co-existing coarctation 6% of patients

Rarely

— Unicuspid valve

— Sub-aortic stenosis

• Discrete

• Diffuse (Tunnel)

• Middle aged patient(4&5th decades) think bicuspid or rheumatic disease

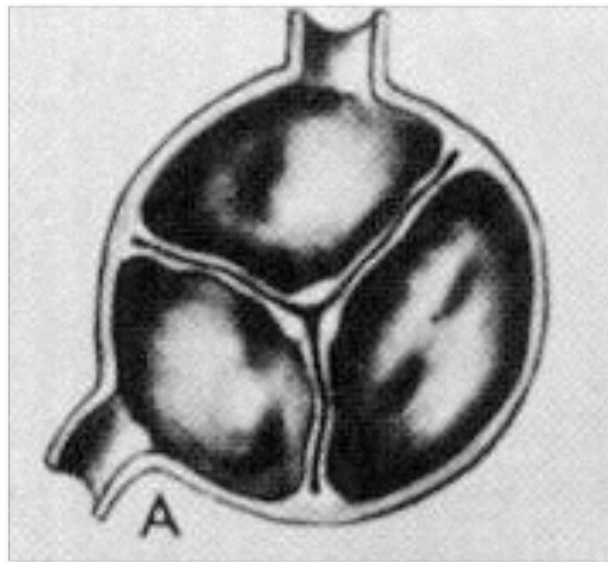
• Old patient think degenerative (6,7,8th decades)



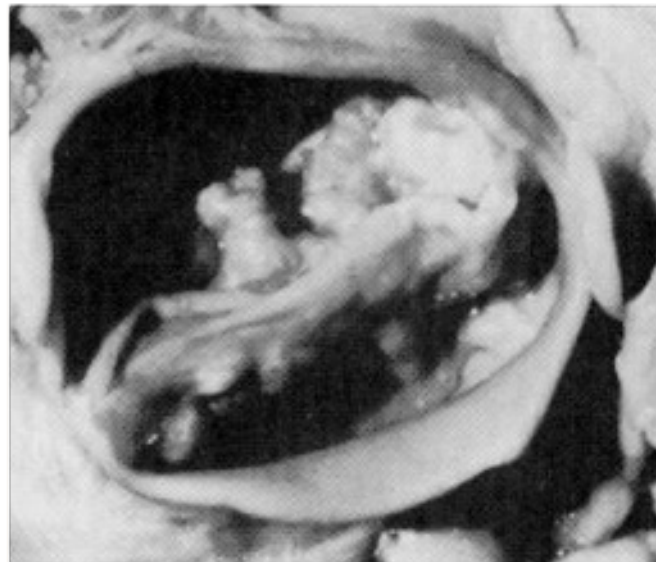
Aortic Stenosis: Etiology

- ◆ Congenital bicuspid valve is the most common abnormality
- ◆ Rheumatic heart disease and degeneration with calcification are found as well

Normal



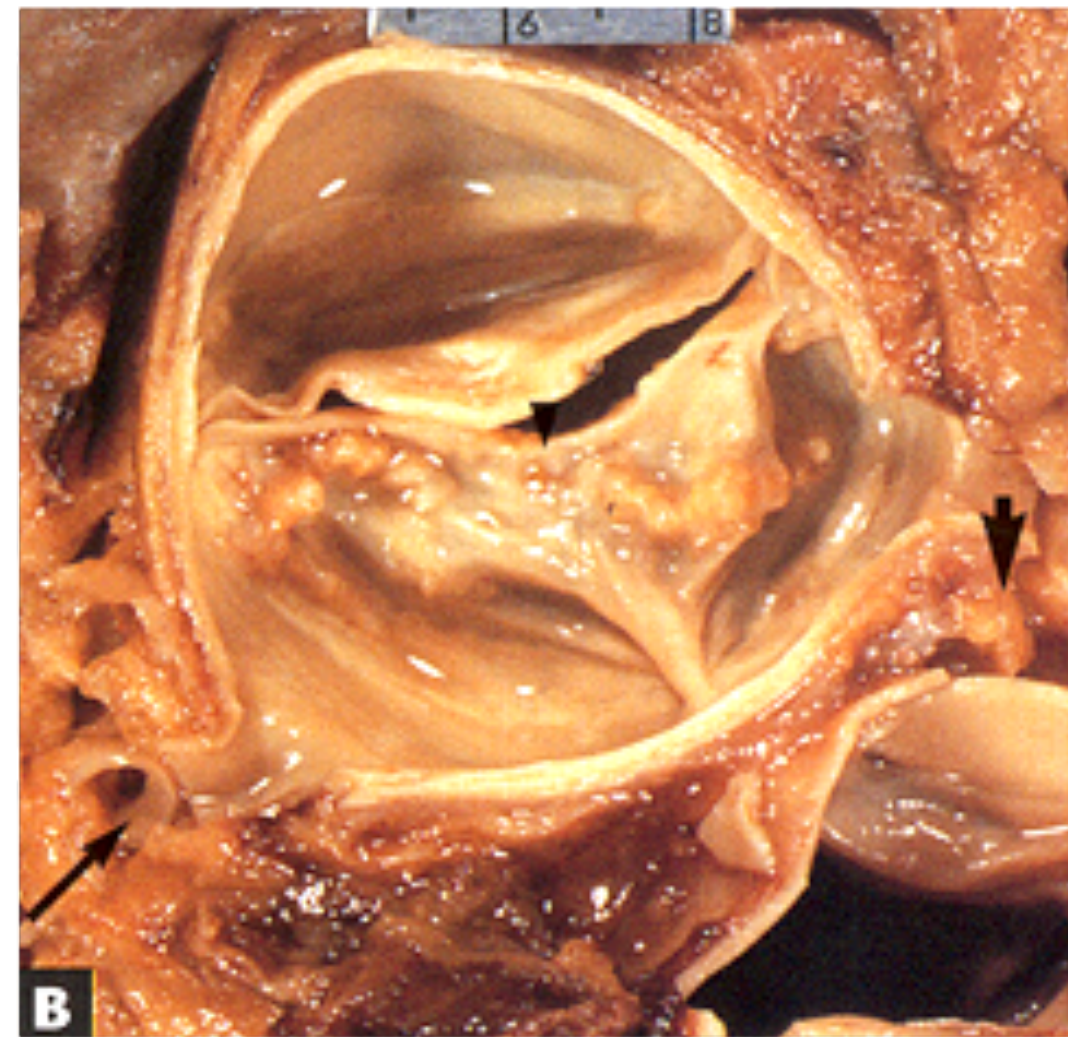
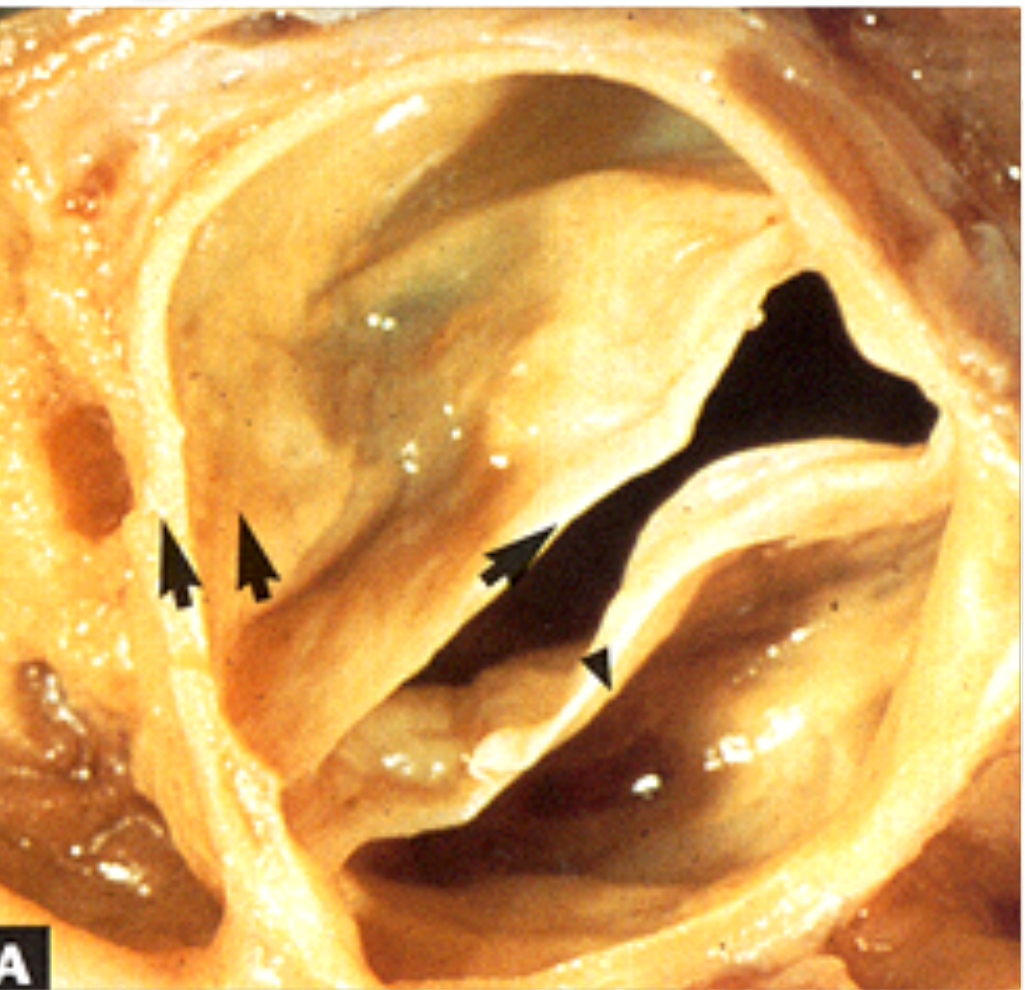
Bicuspid Ao V



“Normal” geriatric
calcific valve

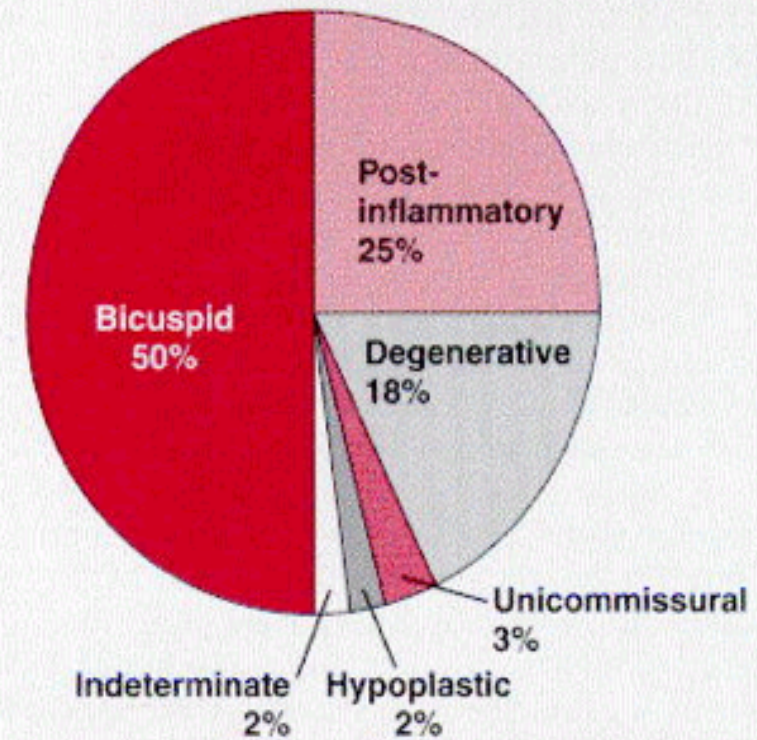


Bicuspid Aortic Valve

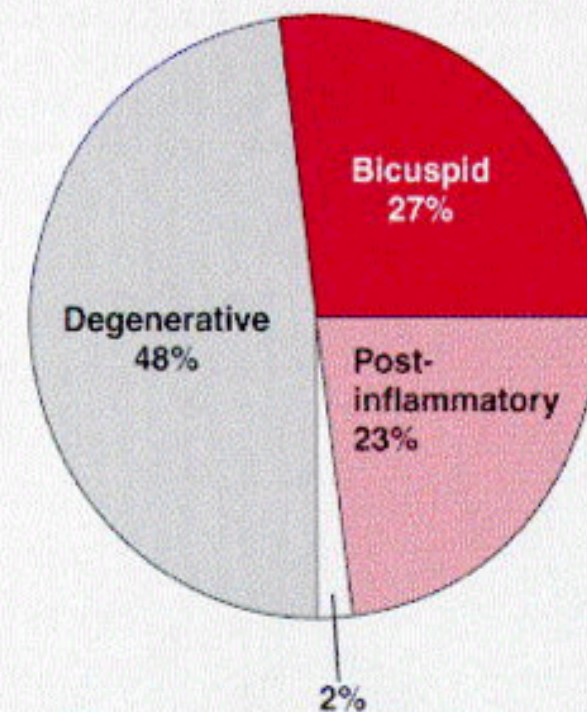


Etiology of Aortic Stenosis

<70 YR OLD (n=324)



≥70 YR OLD (n=322)



Severity of Stenosis

- ◆ Normal aortic valve area $2.5\text{--}3.5\text{ cm}^2$
- ◆ Mild stenosis $1.5\text{--}2.5\text{ cm}^2$
- ◆ Moderate stenosis $1.0\text{--}1.5\text{ cm}^2$
- ◆ Severe stenosis $< 1.0\text{ cm}^2$
- ◆ Onset of symptoms
 - ◆ 0.9 cm^2 with CAD
 - ◆ 0.7 cm^2 without CAD

Aortic Stenosis: Prognosis

Symptom/Sign	Live expectancy
Angina	5 years
Syncope	2-3 years
Congestive Heart Failure	1-2 years

Therapy: Valve replacement for severe aortic stenosis

Operative mortality (elderly) ~ 4-24%/Morbidity ~ 3-11%

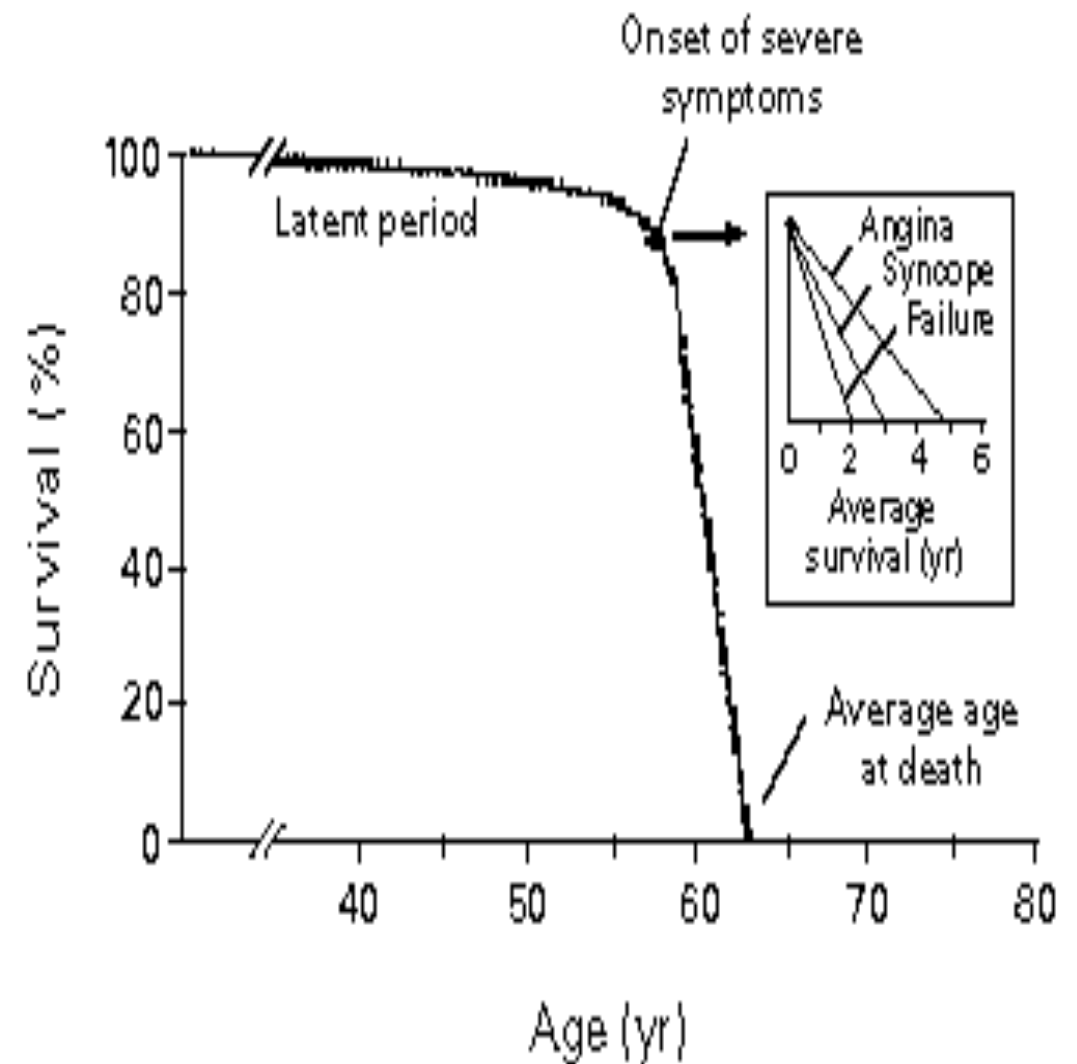
Event rate in asymptomatic severe AS ~ 1%/year

Natural History of Aortic Stenosis

Heart failure reduces life expectancy to less than 2 years

Angina and syncope reduce life expectancy between 2 and 5 years

Rate of progression ↓ @ 0.1 cm²/year

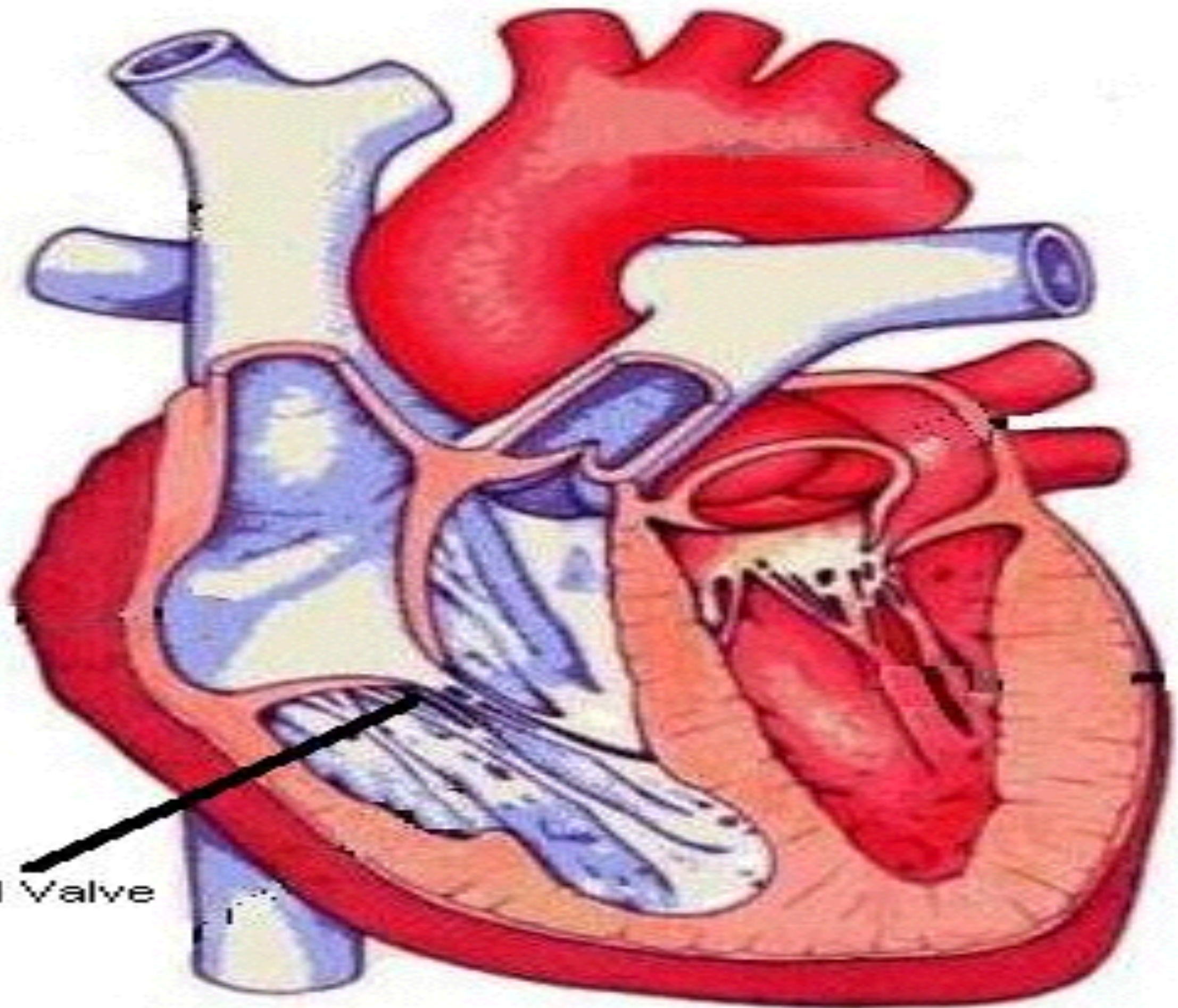


Tricuspid valve disease

Tricuspid Regurgitation

“Type a quote here.”

–Johnny Appleseed



Tricuspid Valve

DEMOGRAPHIC DATA

- ◆ Incidence of tricuspid regurgitation appears to be less than 1%
- ◆ **Mortality/Morbidity** : 3%-RHD, 10% Ebstein's Anomaly,
- ◆ **Race**: No race predilection is apparent.
- ◆ **Sex**: No sex predilection is apparent.
- ◆ **Age**: Congenital, Adolescent, Adults.

CLASSIFICATION OF TR

- ◆ PRIMARY

- ◆ Intrinsic abnormality of the valve apparatus

- ◆ SECONDARY OR FUNCTIONAL

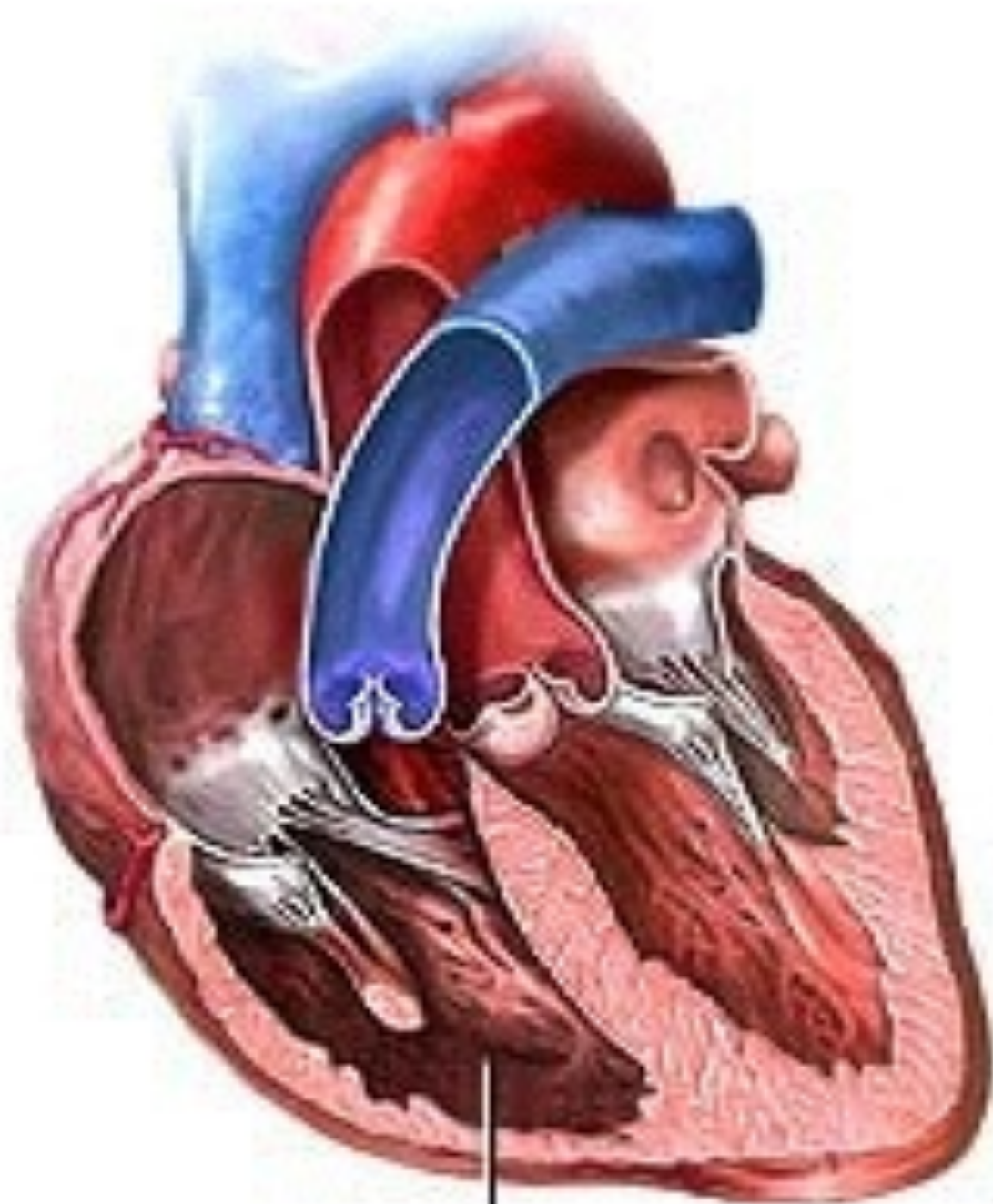
- ◆ Caused by RV pressure or volume overload.

Etiology

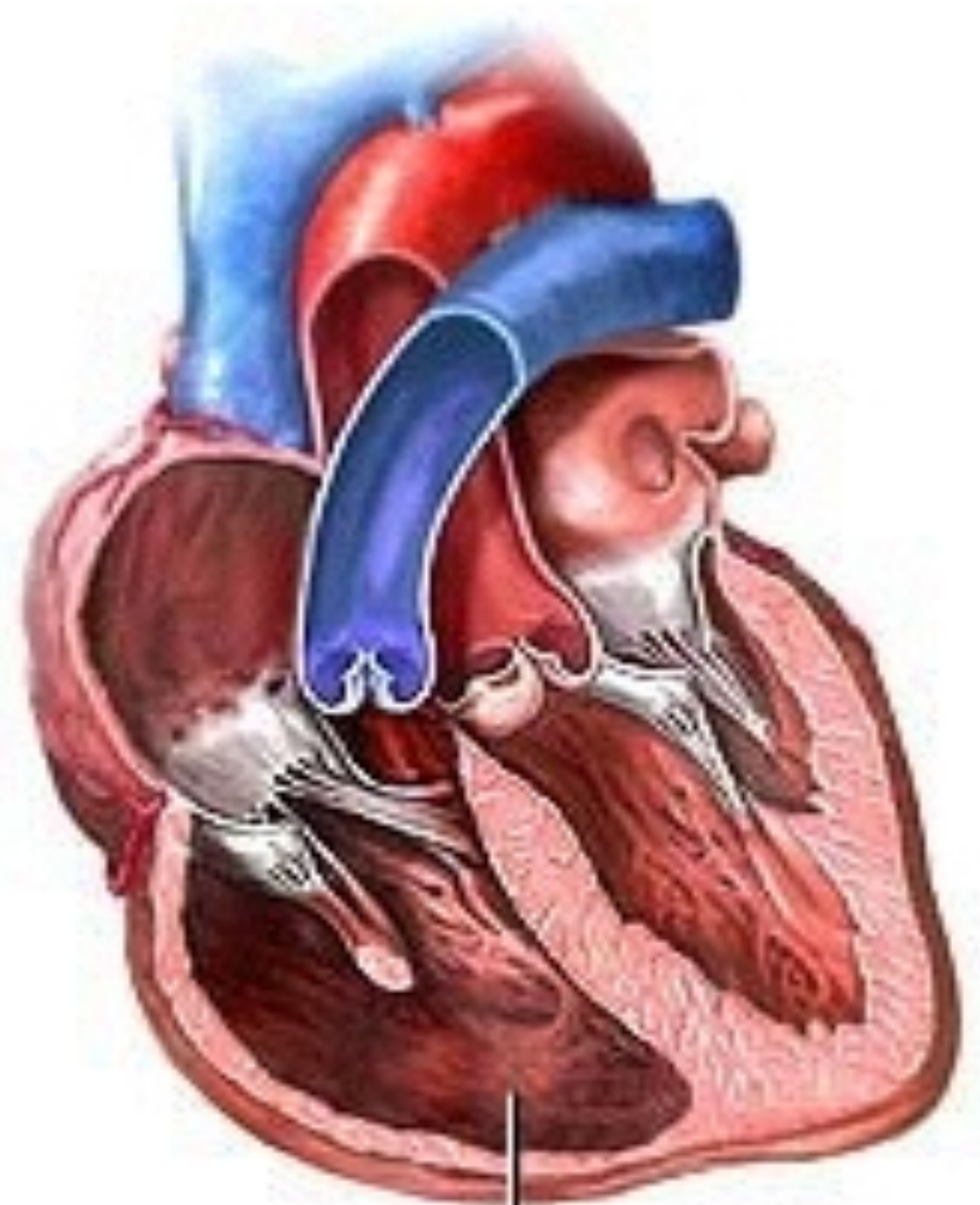
- ♦ Rheumatic heart disease Endocarditis
- ♦ Ebstein anomaly
- ♦ Prolapse (floppy, redundant)
- ♦ Carcinoid
- ♦ Papillary muscle dysfunction
- ♦ Trauma
- ♦ Connective-tissue diseases
- ♦ Anatomically normal tricuspid valves
 - ♦ PHT MR, AR

Pathophysiology

- primary structural abnormalities of the leaflets and chordae
- secondary to myocardial dysfunction and dilatation.



Normal right
ventricle



Enlarged right
ventricle

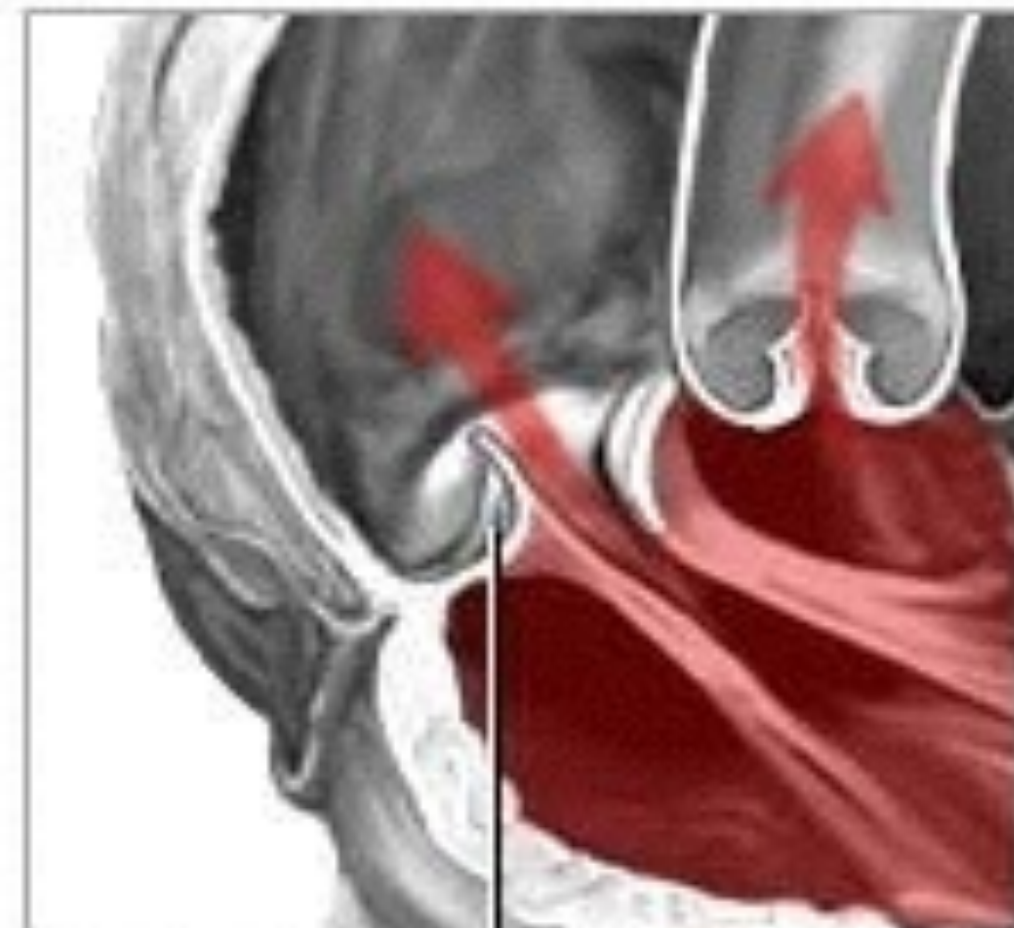
Normal path
of blood flow

1. Right
atrium

Tricuspid
valve

2. Right
ventricle

3. Pulmonary
artery



Malfunctioning tricuspid
valve allows backflow of
blood into the right atrium

Symptoms

- ◆ presents with the signs and symptoms of right-sided heart failure.
- ◆ The spectrum includes
 - ◆ dyspnoea
 - ◆ PND
 - ◆ Jaundice, loss of wt and appetite
 - ◆ ascites
 - ◆ peripheral edema.

Signs

- ◆ S3
- ◆ Jugular venous distention with a prominent V wave:
- ◆ Pansystolic murmur
- ◆ Diminished peripheral pulse volume
- ◆ Pulmonary rales
- ◆ RV heave and gallop
- ◆ Ascites, peripheral edema, cachexia, cyanosis, and jaundice
- ◆ Atrial fibrillation

DIFFERENTIALS

- ◆ Ascites
- Atrial Fibrillation
- Biliary Disease
- Carcinoid Tumor, Intestinal
- Cardiac Cirrhosis
- Cardiogenic Shock
- Cardiomyopathy, Dilated
- Cirrhosis
- Cor Pulmonale
- Ebstein Anomaly
- Eisenmenger Syndrome
- Heart Failure
- Mitral Regurgitation

WORKUP

- ◆ Chest radiography
 - ◆ Marked cardiomegaly is evident.
 - ◆ Evidence of elevated right atrial pressure may include distention of the azygous vein and pleural effusions.
 - ◆ Ascites with diaphragmatic elevation may be present.
 - ◆ Pulmonary arterial and venous hypertension is common.

WORKUP

- ◆ Echocardiography
 - ◆ The right ventricle is dilated.
 - ◆ Paradoxical motion of the ventricular septum III to ASD
 - ◆ Delayed closure of the tricuspid valve is observed.
 - ◆ Prolapse of the tricuspid valve
 - ◆ Vegetations if endocarditis is present.

GRADING

- ◆ Regurgitation jet area / RA area
 - ◆ I – mild < 0.2
 - ◆ II – moderate $0.2 - 0.34$
 - ◆ III – severe > 0.34
- ◆ Presence of negative wave form in pulse wave Doppler tracing of hepatic venous flow – severe TR

WORKUP

- ◆ Electrocardiography
 - ◆ Findings are usually nonspecific.
 - ◆ Incomplete right bundle-branch block, Q waves in lead VI, and atrial fibrillation are found.
- ◆ Cardiac catheterization
 - ◆ Right atrial pressure and RV end-diastolic pressure are elevated. A rise or no change in right atrial pressure on deep inspiration is characteristic of tricuspid regurgitation.
 - ◆ The use of angiography in this setting is controversial.
- ◆ **Lab Studies:**
 - ◆ abnormal liver function and hyperbilirubinemia secondary to liver congestion.

Management

- ◆ **Medical Care:**

- ◆ secondary **TR**
- ◆ adequate control of fluid overload --
Diuretic therapy
- ◆ Treatment of failure symptoms.
- ◆ Interventions to address the primary pathology is of paramount importance.

Surgical Care

TR associated with mitral valve disease and pulmonary hypertension

- ◆ Assess the severity by palpation of the valve at the time of mitral valve intervention.
- ◆ mild tricuspid regurgitation no intervention.
- ◆ ↓ pulmonary vascular pressures with successful mitral valve therapy – tricuspid regurgitation diminishes.
- ◆ Severe regurgitation -- tricuspid annuloplasty.

- ◆ Organic disease of the tricuspid valve
 - ◆ valve replacement.
 - ◆ a porcine heterograft is the valve of choice.
- ◆ Increased incidence of prosthetic valve thrombosis in this low-flow position
 - ◆ Tricuspid valve replacement has been used in carcinoid heart disease and cardiogenic shock with RV infarction, and after cardiac transplantation.

Tricuspid valve stenosis

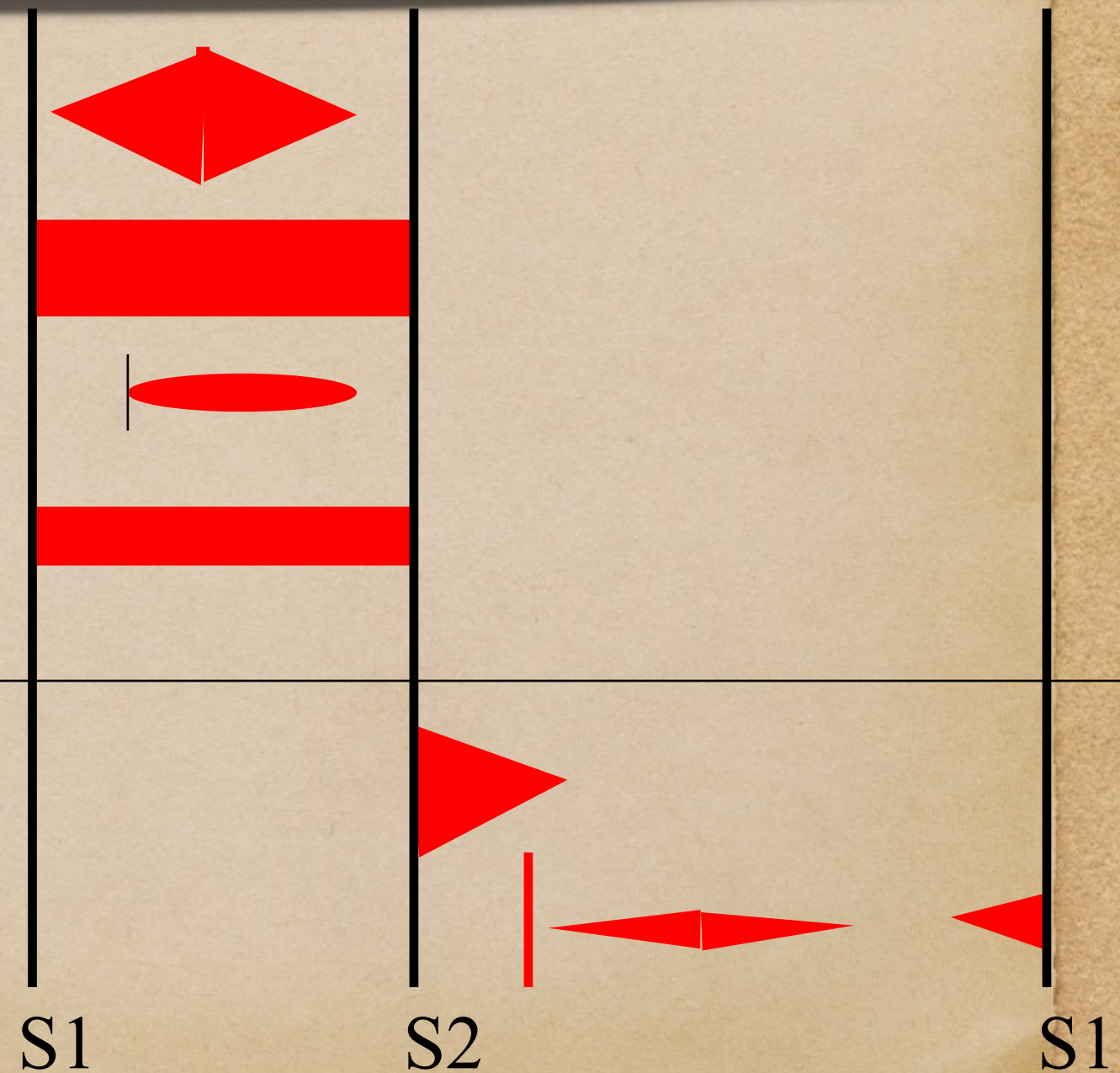
Comparing AS and MR

Systolic Murmurs

- ◆ Aortic stenosis
- ◆ Mitral insufficiency
- ◆ Mitral valve prolapse
- ◆ Tricuspid insufficiency

Diastolic Murmurs

- ◆ Aortic insufficiency
- ◆ Mitral stenosis



Pulmonary valve disease